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Prepared By/Date P. Liddy <i>P. Liddy 4/7/99</i>		Dept. 641	Mail/Addr T487	P. Rutherford <i>Phie Paterlin</i>	<i>4/13/99</i>
				S. Reeder <i>Sam Reeder</i>	<i>4/19/99</i>
				M. Lee <i>R.D. Meyer for M. Lee</i>	<i>4/23/99</i>
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Distribution			Abstract		
*	Name	Mail Addr.	This document provides procedural instructions for the Phase I Final Status Survey of Building 4059 at the Santa Susana Field Laboratory. This procedure complies with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM).		
*	J. Barnes	T487			
*	P. Horton	T038			
*	P. Rutherford (5)	T487			
*	M. Lee	T038			
*	P. Waite	T038			
*	P. Liddy	T487			
*	F. Dahl	T100			
*	R. McGinnis	T487			
*	R. Garrett (2)	T487			
*	D. Trippeda	T038			
*	Rad Safety Files	T487			
*	Engineering Data Mgmt	AB18			
*	Facility Release Files	T487			
*	R. Meyer	T038			
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1.0 INTRODUCTION

The Phase I Final Status Survey for Building 4059 will follow the protocols of the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Reference 8.1. The format of this plan follows closely the format suggested in Appendix A of Reference 8.1.

This procedure provides detail on the MARSSIM methods to be used for the Phase I Final Status Survey. A combination of MARSSIM (see Reference 8.1) protocols and standard Rocketdyne survey techniques will be employed. Each room will be mapped with established Class 1, 2 and 3 survey units. Class 1 survey units will be those rooms/areas that had been contaminated above the DCGL_w during prior remediation operations. This area will include all the basement areas. Class 2 survey units will include those areas where slight contamination may have existed but at lower levels than the DCGL_w. Class 3 survey units will include areas where no contamination existed during the building's history. The maximum allowed size of Class 1 and Class 2 survey units shall be used.

Only activation products (Co-60 and Eu-152/154) have been observed in Building 4059, and no alpha emitters have ever been detected, therefore only beta scans and measurements will be performed. A 100% surface beta scan of Class 1 surfaces will be conducted. A 20% surface beta scan of Class 2 surfaces (including upper walls above 2 meters and ceilings) will be conducted. The number of stationary beta measurements in each survey unit will be based on the statistical models recommended in MARSSIM. One-minute total and removable beta surface contamination measurements will be performed. The gross beta DCGL_w will be 5,000 dpm/100cm² total beta and 1,000 dpm/100cm² removable beta.

Since MARSSIM does not explicitly cover volumetric activation, Rocketdyne will also take 1-minute gamma exposure measurements at 1-meter and at floor surfaces. These will be taken at the same floor locations as the stationary beta contamination measurements. Since surface contamination measurements will be background subtracted based on daily instrument performance checks, the resulting data set will be interpreted and analyzed using the Sign Test method as described in MARSSIM.

The two phased approaches to the release of the Building 4059 site are the safest for the worker and most cost effective for the demolition and removal. This approach is the best path to our goal of no significant impact on public health and safety and a site released for unrestricted use.

2.0 FACILITY HISTORY

2.1 Background

Building 4059 (see Figure 1), located in Area IV at Rocketdyne's SSFL, has a large below-grade test vault with two reactor test cells and below grade support rooms. It was used in the late 1960s for ground-testing the Space Nuclear Auxiliary Power (SNAP) prototype reactor, S8DR. During the early 1970s, following successful completion of the ground tests, the reactor and the north reactor test cell portion of the liquid metal heat transfer circuits was removed. All reactor systems were removed intact and no loose, surface contamination was present after the reactor systems were removed. The facility was then placed under a maintenance and surveillance regime while waiting for future decontamination and decommissioning (D&D).

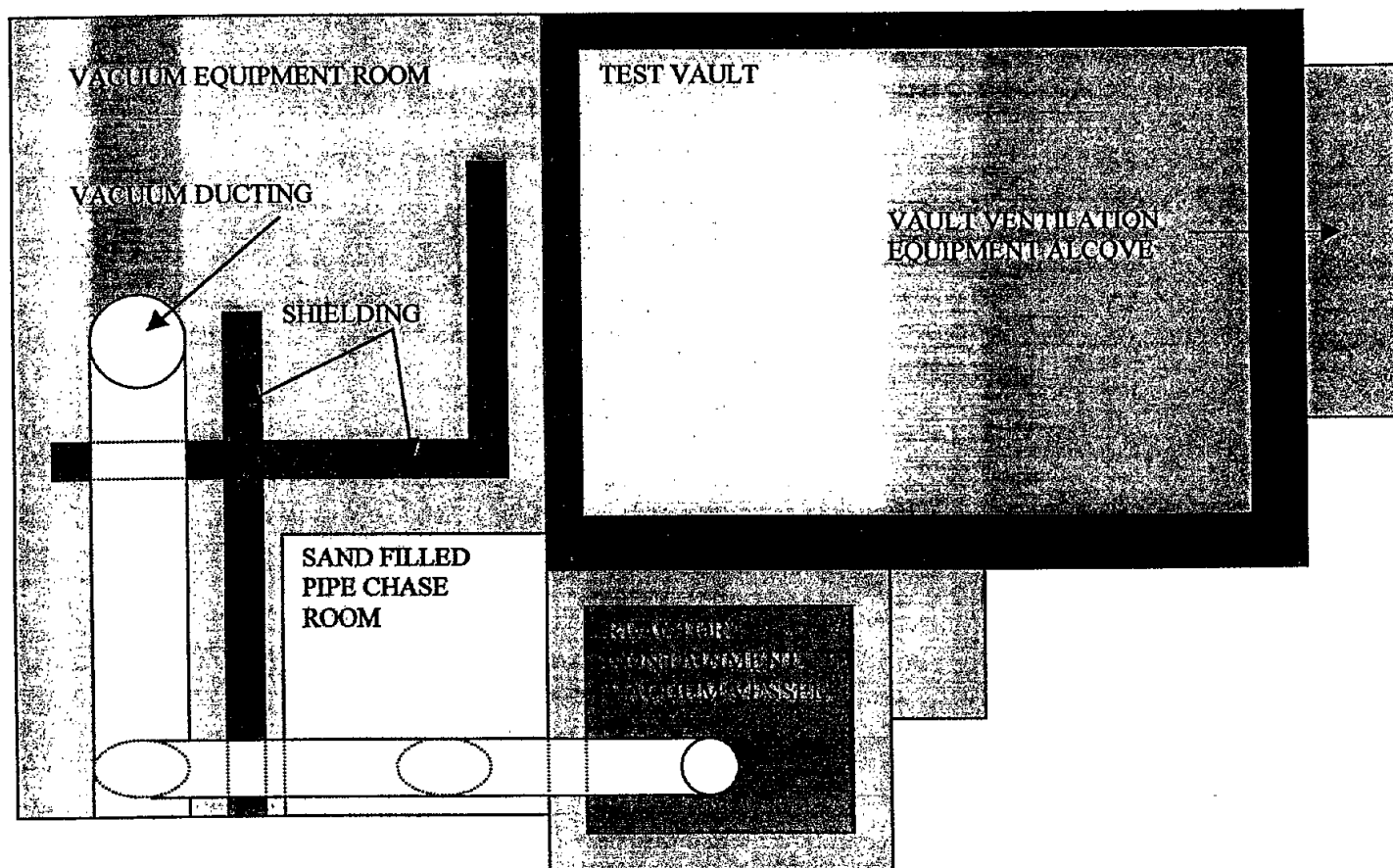


FIGURE 1: BUILDING 4059 OVERVIEW

DOE funded the D&D program to be initiated in 1987. The overall objectives of the Building 4059 Remediation Program performed by Rocketdyne for the Department of Energy (DOE) were threefold:

1. Prevent radiological contamination of the environment
2. Remove all radiological activated material above Federal and State of California designated unrestricted release limits from within the building and its structure
3. Restore the site to conditions suitable for release without radiological restrictions in compliance with DOE guidelines, the Formerly Used Site Remedial Action Program (FUSRAP) and Surplus Facilities Management Program (SFMP).

The most highly activated sources of radioactive materials were removed in the first stages of the program. The Pipe Chase Room was emptied of sand and the 5-foot diameter vacuum duct was sectioned and packaged for disposal. The large vacuum vessel was remotely sectioned and removed and the entire north test cell shielding concrete was broken up, packaged and shipped to disposal. Steel liners were removed from both test cells, leaving only the neutron-activated materials within the test facility walls, ceilings and floors; primarily Europium-152 (concrete aggregate) and Cobalt-60 (rebar and facility wall liner material).

This fiscal year, 1999, the facility is being cleaned of low levels of surface contamination resulting from D&D activities, primarily from the size reduction and packaging of activated materials. In addition, the facility structural materials are being sampled by core drilling near the test vaults to determine the extent or boundary of activated materials above unrestricted release criteria. The areas outside this boundary would only be subject to surface contamination and could therefore be released for unrestricted use by cleaning and subsequent radiological verification survey of the surfaces.

2.2 Preferred Approach to Facility Demolition and Site Release

Activated structural materials at levels higher than releasable limits remain in the support columns and walls immediately adjacent to the test cell at 50 feet below grade. An assessment by a structural engineer has concluded that any further removal of structural materials in the test vault area will compromise the structural integrity of the building and endanger personnel working below grade. Removal of the activated structural materials prior to removal of rest of the massive facility structure above these activated materials would require designing and constructing alternate structural supports for the facility walls, etc. Choosing this approach would extend the schedule and increase costs unnecessarily.

A viable, reasonable and safer alternative is to perform the Building 4059 site release in two phases. In Phase I, the above grade building and the below grade portions (excluding the activated concrete in the north test vault) will be decontaminated, surveyed, released for demolition, and demolished.

In Phase II of the Building 4059 project, the remaining activated concrete in the test vault in the basement will be removed, packaged and disposed of as radioactive waste. The remaining excavation will then be sampled, surveyed, cleaned if necessary, and released.

This is a similar approach to that used previously at Building 4064. The facility building was first surveyed and released, and then demolished and sent to off site landfill disposal. In the second phase of the Building 4064 project, after all the structures had been removed, the site grounds were final surveyed and released. The recommended sequence for Building 4059 is outlined below and the physical division of the two phases is described as follows:

PHASE I

1. Characterize and define the area (volume) of the facility that will be treated as radioactive waste by core sampling the concrete and steel liner and performing analyses to segregate "clean" volume from activated material.
2. Clean all other areas of the facility with the purpose of preparing for final survey and release of these areas containing no internal activation.

DOE (Reference 8.8) and DHS (Reference 8.9) have approved the two-Phase approach (see Reference 8.2). Step 1 above has been completed and documented. Step 2 above has also been completed. This procedure describes the survey required to implement step 3.

3. Perform final release survey of non-activated above and below grade areas to be removed as non-radiological materials (Phase I).
4. Perform verification surveys by ORISE and DHS of the Phase I portion of the facility.
5. Receive DOE release and DHS concurrence for Phase I.
6. Implement demolition contractor provided plan for physical barriers to prevent "released" demolition debris from entering areas of the facility with remaining activated material.
7. Perform demolition and debris removal of "clean" portion of the facility. (Phase I completed).

PHASE II

1. Perform demolition of activated facility structural materials (Phase II portion of facility) and package for radioactive waste disposal.
2. Perform final release survey of excavation.
3. Perform verification surveys of excavation by ORISE and DHS.
4. Receive DOE release and DHS concurrence.
5. Backfill excavation and restore site.

3.0 SURVEY DESIGN

3.1 Identification of Radionuclides of Concern

Surveys during remediation confirmed that activation products, primarily Co-60, are present. Cobalt-60 is found in the facility walls, liners, and rebar. In addition trace Eu-152, and Eu-154 has been found in the concrete aggregate.

3.2 Derived Concentration Guideline Limits (DCGLw).

The objective of this survey is to demonstrate that residual surface contamination, in excess of the release criterion, is not present at this site. The DCGLw for Co-60 used for evaluating survey results is 5000 dpm/100cm² fixed and 1000 dpm/100cm² removable for surface contamination of structures. Concrete and steel core surfaces taken in the Building 4059 basement indicate that volumetric activation of building materials in the Phase I portion of the building survey are negligible to zero (see Reference 8.2).

3.3 Classification of Areas Based on Contamination Potential.

The facility consists of one building situated on approximately 1.2 acres of land. The building subsurface area is a concrete block structure on a poured concrete slab with a poured concrete ceiling. The surface structure, with the exception of the high bay, is a single story, with numerous rooms, partitioned with drywall and a corrugated steel roof. The high bay is constructed of concrete and corrugated steel. The facility is surrounded by a chain-link fence. The subsurface structure is divided into numerous rooms made of concrete. The outside area is covered with asphalt, and the northwest end was used as the employee parking lot, and truck access to the shipping/receiving areas. Previous surveys were reviewed and the results were determined to be appropriate for planning the Final Status Survey.

3.3.1 Class I

Class I survey units will be those rooms and areas having known contamination above DCGL's during prior remediation operations which will include all basement areas of Building 4059. These include areas having known >5000 dpm/100cm² fixed contamination and >1000 dpm/100cm² removable contamination.

3.3.2 Class II

Class II survey units will include those areas where contamination existed below DCGLs during remedial operations. Those areas include the High Bay, Stairwells, and Building 459. These include areas between 1000 and 5000 dpm/100cm² fixed contamination; and between 200 and 1000 dpm/100cm² removable contamination.

3.3.3 Class III

Class III survey units include areas where negligible or no contamination existed during Building 4059's history. Class III areas include the office areas, Control Room, Equipment Room, Electrical Room, Noble Gas Room, and all other areas above ground inside building 4059 and outside roof area. These include areas $<1000 \text{ dpm}/100\text{cm}^2$ fixed contamination; and $<200 \text{ dpm}/100\text{cm}^2$ removable contamination.

3.4 Identification of Class I, II and III Areas

3.4.1 Based on the results of other decommissioning surveys at the site, and the operating history, the following Class I, II, and III areas were used to design the Final Status Survey. All of the Class I, Class II interior surface areas are concrete. Most Class III areas are drywall and corrugated steel. The Figure 2 Plot Plan for Building 4059 is shown below. The entire basement area is designated Class I, with the exception of the reactor pits which will be addressed in the Phase II operations, and the stairwells which are Class II.

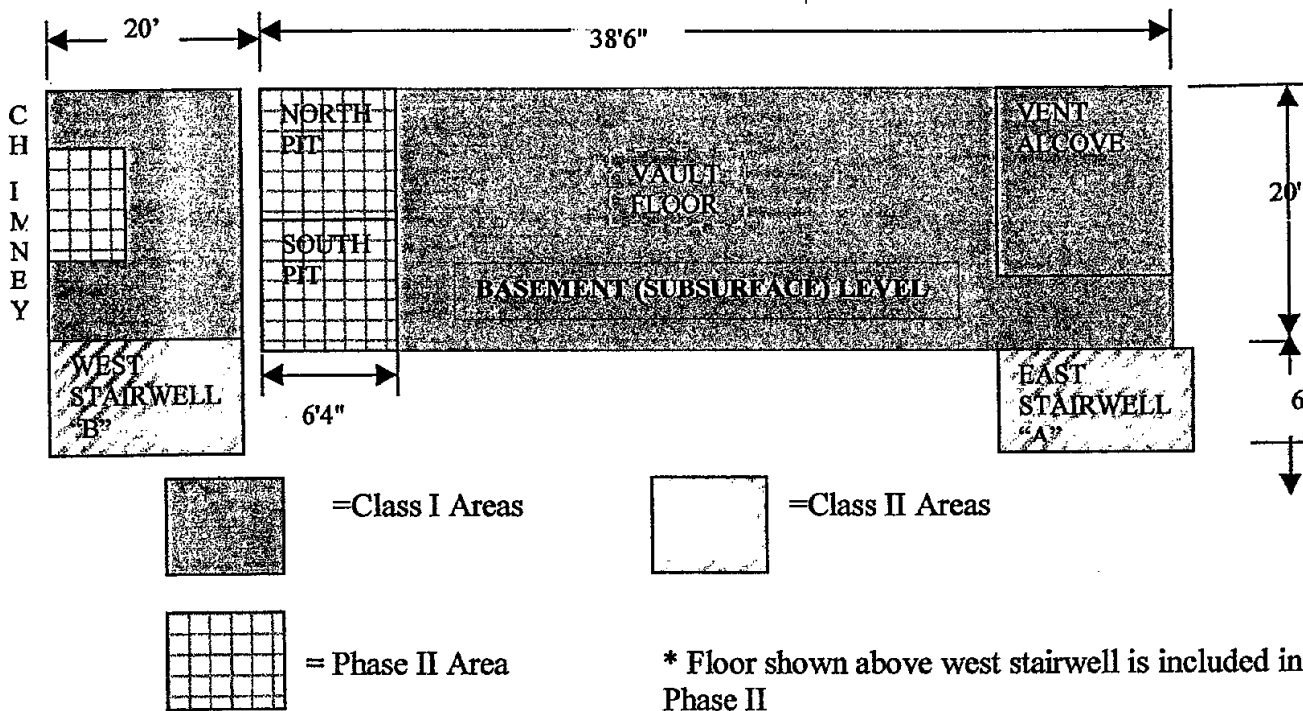


FIGURE 2: BUILDING 4059 CLASS I FLOOR PLAN (BASEMENT LEVEL)

3.4.2 Figure 3 shows the Class II and III areas. Only the High Bay and stairwells are Class II.

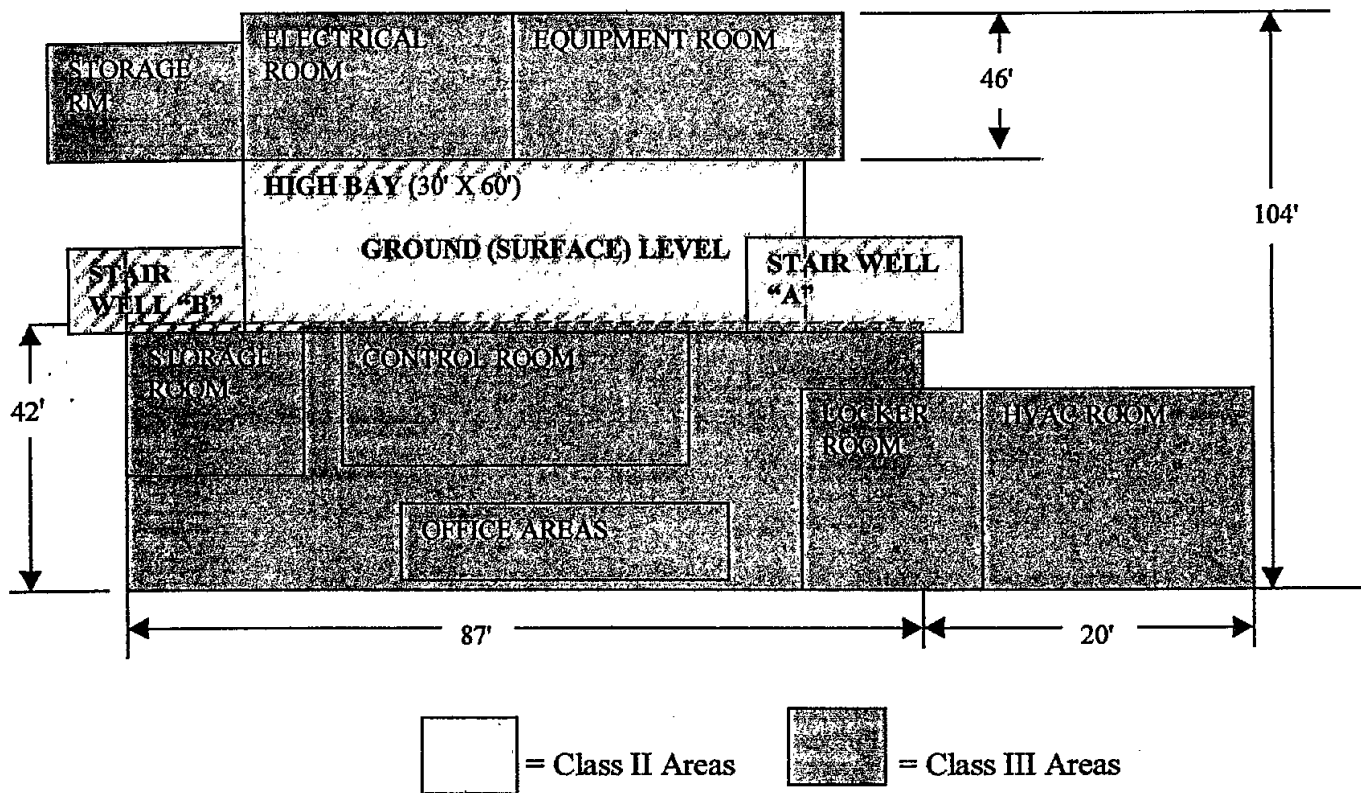


FIGURE 3: CLASS II AND III FLOOR PLAN (GROUND FLOOR LEVEL)

3.4.3 Table 1 of the MARSSIM Manual, Roadmap-6, limits the survey unit area as follows:

CLASSIFICATION	MAX SURVEY UNIT AREA
CLASS I	100 m ²
CLASS II	1000 m ²
CLASS III	UNLIMITED

TABLE 1: AREA CLASSIFICATION

3.5 Decision Objectives

The decision objectives are as follows:

- The objective of this survey is to achieve release for unrestricted use.
- The null hypothesis (H_0) for each survey unit is that the residual radioactivity concentrations exceed the release criterion. The null hypothesis for all survey units must be rejected for the site to be released for unrestricted use.
- Acceptable decision error probabilities shall be alpha [α *regulators risk* = 0.05 and beta [β *users risk* = 0.05. α is defined as the probability that the null hypothesis will be rejected when in fact it is true, such as when "a contaminated site is declared clean". β is defined as the probability that the null hypothesis will be accepted when in fact it is false or when "a clean site is declared contaminated".
- The Derived Concentration Guideline (DCGL_w) for the primary contaminant of concern shall be 5000 dpm/100cm² of Co-60.
- The Lower Bound of the Gray Area (LBGR) shall be one half of the DCGL_w or 2500 dpm/100cm² surface contamination.
- The regulator's risk (α) shall be established at the DCGL_w.
- The user's (Rocketdyne) risk β shall be established at the LBGR.

3.5.1 Power Chart

The Gray Region of the Power Chart extends from 2500 to 5000 dpm/100cm² for total beta contamination. The survey is designed for the statistical test to have 95% power to decide a survey unit containing less than 2500 dpm/100cm² meets the release criteria. For the same test, a survey unit containing over 5000 dpm/100cm² has less than a 5% probability of being released.

3.6 Number of Survey Units

Survey Units will be labeled alpha-numerically. For structural surfaces consisting of beams, pipes, conduits, and other surfaces that are not accessible to large surface measurements, a section of structural run is randomly selected within the survey unit sample point for surveying.

The Class I area (911 m²) will consist of 10 survey units each of ≤ 100 m².

The Class II areas (1900 m²) will consist of 3 survey units each of ≤ 1000 m²

The Class III areas (3100 m²) will consist of 1 survey unit of unlimited dimensions.

3.7 Determination of Sample Point Numbers

Twenty Sample points will be required per Survey Unit.

The shift Δ is the $DCGL_w$ minus the LBGR. In other words, the shift is the width of the Gray Region. σ is the expected standard deviation of the measurements of the survey unit. Based on prior surveys of Building 4059, the σ for total contamination is $829 \text{ dpm}/100\text{cm}^2$.

The relative shift is therefore:
$$\frac{5000 - 2500}{829} = 3$$

From Table 5.5 of Reference 8.1, the number of samples required for a relative shift of 3 and $\alpha = \beta = 0.05$ is 14 in each survey unit. A conservative factor of 40% was applied, bringing the total to 20 sample points.

Twenty sample points will be required per Survey Unit

3.7.1 Total Number of Sample Points

The total number of sample points in each Class area are:

- Class I: 20 data points per survey unit. (10 survey units * 20 points = 200 points).
- Class II: 20 data points per survey unit (3 survey units * 20 points = 60 points).
- Class III: 20 data points per survey unit (1 survey unit * 20 points = 20 points).

3.7.2 Survey Unit Area

Table 2 depicts the individual Class areas divided up into individual Survey Units to maintain the area limitations of Table 1 above.

CLASS	SURVEY UNIT	LOCATION	TOTAL AREA per Survey Unit	SAMPLE GRID AREA	GRID SPACING
Class I	SU1	Alcove	87.8 m ²	4.39 m ²	2.09 meters
Class I	SU2	East Wall	83.2 m ²	4.16 m ²	2.03 meters
Class I	SU3	Floor	65 m ²	3.25 m ²	1.80 meters
Class I	SU4	North Wall	98.4 m ²	4.92 m ²	2.21 meters
Class I	SU5	West Wall	83.2 m ²	4.16 m ²	2.03 meters
Class I	SU6	South Wall	98.4 m ²	4.92 m ²	2.21 meters
Class I	SU7	Ceiling	98.4 m ²	4.92 m ²	2.21 meters
Class I	SU8	VER	99 m ²	4.95 m ²	2.22 meters
Class I	SU9	VER	99.4 m ²	4.97 m ²	2.22 meters
Class I	SU10	VER	98.1 m ²	4.90 m ²	2.21 meters
Class II	SU11	High Bay	868.5 m ²	43.4 m ²	6.58 meters
Class II	SU12A	East Stairwell	220.4 m ²	11.0 m ²	3.31 meters
Class II	SU12B	West Stairwell	166.3 m ²	8.3 m ²	2.88 meters
Class II	SU13	Building 459	645 m ²	32.2 m ²	5.67 meters
Class III	SU14	All other areas	3100 m ²	Random	Random

TABLE 2: SURVEY UNIT AREAS

3.73 Two random numbers between zero and one were generated to locate the random starting point for the survey unit. Using Table I.6 of MARSSIM, Appendix I, 0.296926 and 0.222167 were selected. They are calculated in Table 3 as follows:

CLASS	SURVEY UNIT	X * LENGTH	Y * WIDTH OR HEIGHT	ORIGIN CORNER	STARTING POINT COORDINATES
I	1	9.44 * 0.296926	9.29 * 0.222167	Southwest	X = 2.74, Y = 2.05
I	2	9.75 * 0.296926	8.53 * 0.222167	Lower Left	X = 2.83, Y = 1.88
I	3	8.53 * 0.296926	7.62 * 0.222167	Southwest	X = 2.47, Y = 1.68
I	4	11.73 * 0.296926	8.38 * 0.222167	Lower Left	X = 3.4, Y = 1.84
I	5	9.75 * 0.296926	8.53 * 0.222167	Lower Left	X = 2.83, Y = 1.88
I	6	11.73 * 0.296926	8.38 * 0.222167	Lower Left	X = 3.4, Y = 1.84
I	7	11.73 * 0.296926	8.38 * 0.222167	Southwest	X = 3.4, Y = 1.84
I	8	15.85 * 0.296926	6.24 * 0.222167	Lower Left	X = 4.6, Y = 1.37
I	9	16.21 * 0.296926	6.09 * 0.222167	Lower Left	X = 4.6, Y = 1.37
I	10	10.05 * 0.296926	9.75 * 0.222167	Lower Left	X = 2.92, Y = 2.15
II	11	31.5 * 0.296926	27.5 * 0.222167	Southwest	X = 7.98, Y = 5.5
II	12A	20 * 0.296926	11 * 0.222167	Southwest	X = 5.8, Y = 2.42
II	12B	17.5 * 0.296926	9.5 * 0.222167	Southwest	X = 5.8, Y = 2.09
II	13	26.5 * 0.296926	24.5 * 0.222167	Southwest	X = 7.69, Y = 5.39
III	14	Random	Random	Southwest	Random

TABLE 3: ESTABLISHING RANDOM STARTING POINTS

3.8 Survey Unit Grids and Spacing

The following Survey Units' surface area, number of sample points, random starting points, and the distance apart were used to determine the following sample point locations. The 20 survey points will remain the correct distance apart when drawn at the distances from the lower left-hand corner :

3.8.1 Class I, Survey Unit 1, Alcove, measuring from the southwest corner (origin), draw a circle at the distances identified below:

Horizontal distances from the left-hand corner:	Vertical distances from the left-hand corner:	Horizontal and Vertical Distances Apart by:	Random Starting Point Coordinates:
0.65		2.09 meters	(2.74, 2.05)
2.74	2.05		
4.83	4.14		
6.92	6.23		
9.01	8.32		

TABLE 4: SURVEY UNIT 1 COORDINATES

The following map is an example of using the measurements above to draw out the Survey Unit lines and sample points:

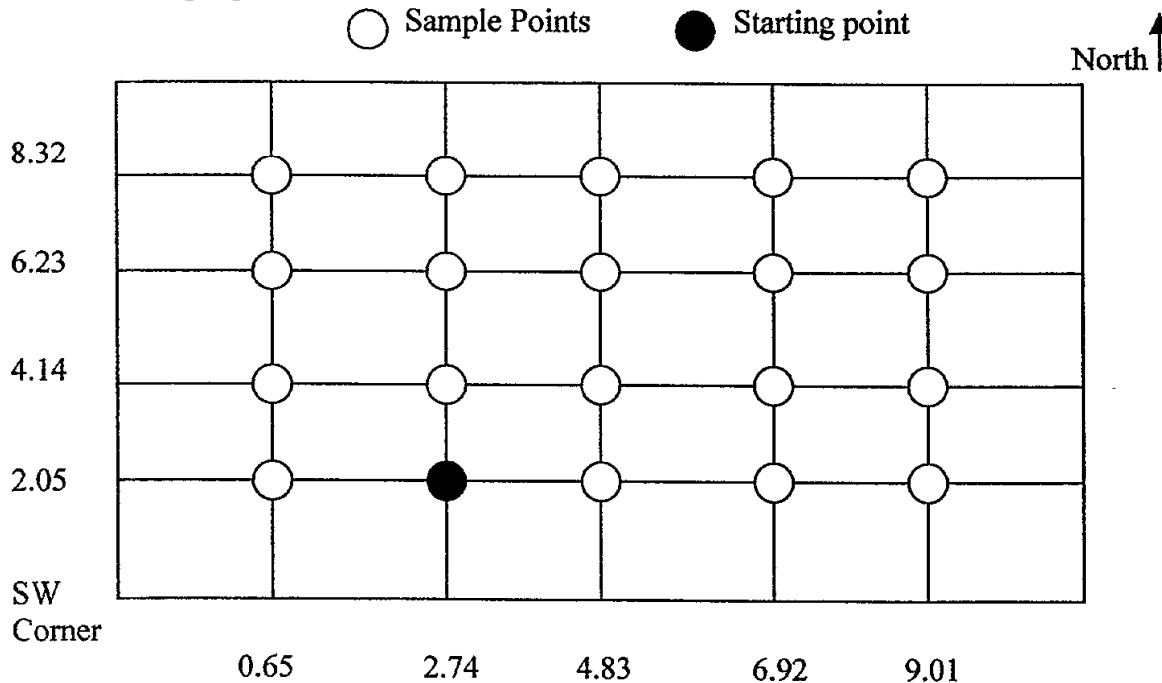


FIGURE 4: SURVEY UNIT 1 SAMPLE POINT LOCATIONS

- 3.8.2 Class 1, Survey Unit 2, East Wall, measuring from the lower left-hand corner origin, draw circles at these distances:

Horizontal distances from the left-hand corner:	Vertical distances from the left-hand corner:	Horizontal and Vertical Distances Apart by:	Random Starting Point Coordinates:
0.80		2.03 meters	(2.83,1.88)
2.83	1.88		
4.86	3.91		
6.89	5.94		
8.92	7.97		

TABLE 5: SURVEY UNIT 2 COORDINATES

- 3.8.3 Class 1, Survey Unit 3, Basement Floor, measuring from the southwest corner origin, draw circles at these distances:

Horizontal distances from the left-hand corner:	Vertical distances from the left-hand corner:	Horizontal and Vertical Distances Apart by:	Random Starting Point Coordinates:
0.67		1.8 meters	(2.47, 1.68)
2.47	1.68		
4.27	3.48		
6.07	5.28		
7.87	7.08		

TABLE 6: SURVEY UNIT 3 COORDINATES

- 3.8.4 Class 1, Survey Unit 4, North Wall, measuring from the lower left hand corner origin, draw circles at these distances:

Horizontal distances from the left-hand corner:	Vertical distances from the left-hand corner:	Horizontal and Vertical Distances Apart by:	Random Starting Point Coordinates:
1.19		2.21 meters	(3.4, 1.84)
3.4	1.84		
5.61	4.05		
7.82	6.26		
10.03	8.47		

TABLE 7: SURVEY UNIT 4 COORDINATES

3.8.5 Class 1, Survey Unit 5, West Wall, measuring from the lower left hand corner origin, draw circles at these distances:

Horizontal distances from the left-hand corner:	Vertical distances from the left-hand corner:	Horizontal and Vertical Distances Apart by:	Random Starting Point Coordinates:
0.80		2.03 meters	(2.83, 1.88)
2.83	1.88		
4.86	3.91		
6.89	5.94		
8.92	7.97		

TABLE 8: SURVEY UNIT 5 COORDINATES

3.8.6 Class 1, Survey Unit 6, South Wall, measuring from the lower left hand corner origin, draw circles at these distances:

Horizontal distances from the left-hand corner:	Vertical distances from the left-hand corner:	Horizontal and Vertical Distances Apart by:	Random Starting Point Coordinates:
1.19		2.21 meters	(3.4, 1.84)
3.4	1.84		
5.61	4.05		
7.82	6.26		
10.03	8.47		

TABLE 9: SURVEY UNIT 6 COORDINATES

3.8.7 Class 1, Survey Unit 7, Ceiling, measuring from the southwest corner origin, draw circles at these distances:

Horizontal distances from the left-hand corner:	Vertical distances from the left-hand corner:	Horizontal and Vertical Distances Apart by:	Random Starting Point Coordinates:
1.19		2.21 meters	(3.4, 1.84)
3.4	1.84		
5.61	4.05		
7.82	6.26		
10.03	8.47		

TABLE 10: SURVEY UNIT 7 COORDINATES

- 3.8.8 Class 1, Survey Unit 8, VER Ceiling/West Wall and Chimney, measuring from the bottom left corner of the west wall, draw circles at these distances:

Horizontal distances from the left-hand corner:	Vertical distances from the left-hand corner:	Horizontal and Vertical Distances Apart by:	Random Starting Point Coordinates:
1.38		2.22 meters	(4.6, 1.37)
4.6	1.37		
6.82	3.59		
9.04	5.81		
11.26	8.03		

TABLE 11: SURVEY UNIT 8 COORDINATES

- 3.8.9 Class 1, Survey Unit 9, VER North and South Walls, measuring from the bottom left corner of the north wall, draw circles at these distances:

Horizontal distances from the left-hand corner:	Vertical distances from the left-hand corner:	Horizontal and Vertical Distances Apart by:	Random Starting Point Coordinates:
1.38		2.22 meters	(4.6, 1.37)
4.6	1.37		
6.82	3.59		
9.04	5.81		
11.26	8.03		

TABLE 12: SURVEY UNIT 9 COORDINATES

- 3.8.10 Class 1, Survey Unit 10, VER East Wall plus 19.5m² from floor, measuring from the bottom left-hand corner of the east wall, draw circles at these distances:

Horizontal distances from the left-hand corner:	Vertical distances from the left-hand corner:	Horizontal and Vertical Distances Apart by:	Random Starting Point Coordinates:
0.71		2.21 meters	(2.92, 2.15)
2.92	2.15		
5.13	4.36		
7.34	6.57		
9.55	8.78		

TABLE 13: SURVEY UNIT 10 COORDINATES

3.8.11 Class II, Survey Unit 11, High Bay, measuring from the southwest corner of the floor, draw circles at these distances:

Horizontal distances from the left-hand corner:	Vertical distances from the left-hand corner:	Horizontal and Vertical Distances Apart by:	Random Starting Point Coordinates:
0.03		6.58 meters	(7.61, 5.77)
7.61	5.77		
14.19	12.35		
20.77	18.93		
27.35	25.51		

TABLE 14: SURVEY UNIT 11 COORDINATES

3.8.12 Class II, Survey Unit 12A, East Stairwell, measuring from the southwest corner of the floor, draw lines on the floor and continuing up the walls, draw circles at these distances:

Horizontal distances from the left-hand corner:	Vertical distances from the left-hand corner:	Horizontal and Vertical Distances Apart by:	Random Starting Point Coordinates:
1.0		3.31 meters	(4.31, 3.27)
4.31	3.27		
7.62	6.58		
10.93	9.89		
14.24	13.20		

TABLE 15: SURVEY UNIT 12A COORDINATES

3.8.13 Class II, Survey Unit 12B, West Stairwell, measuring from the southwest corner of the floor, draw lines on the floor and continuing up the walls, draw circles at these distances:

Horizontal distances from the left-hand corner:	Vertical distances from the left-hand corner:	Horizontal and Vertical Distances Apart by:	Random Starting Point Coordinates:
0.83		2.88 meters	(3.71, 2.82)
3.71	2.82		
6.59	5.70		
9.47	8.58		
12.05	11.45		

TABLE 16: SURVEY UNIT 12B COORDINATES

3.8.14 Class II, Survey Unit 13, Building 459, measuring from the southwest corner of the floor, draw lines on the floor and continuing up the walls, draw circles at these distances:

Horizontal distances from the left-hand corner:	Vertical distances from the left-hand corner:	Horizontal and Vertical Distances Apart by:	Random Starting Point Coordinates:
5.75		5.67 meters	(11.42, 8.66)
11.42	8.66		
17.09	14.33		
22.76	20.00		
28.43	25.67		

TABLE 17: SURVEY UNIT 13 COORDINATES

3.8.15 Class III, Survey Unit 14, office and outer room areas:

Class III points will be taken in individual rooms and outside areas.

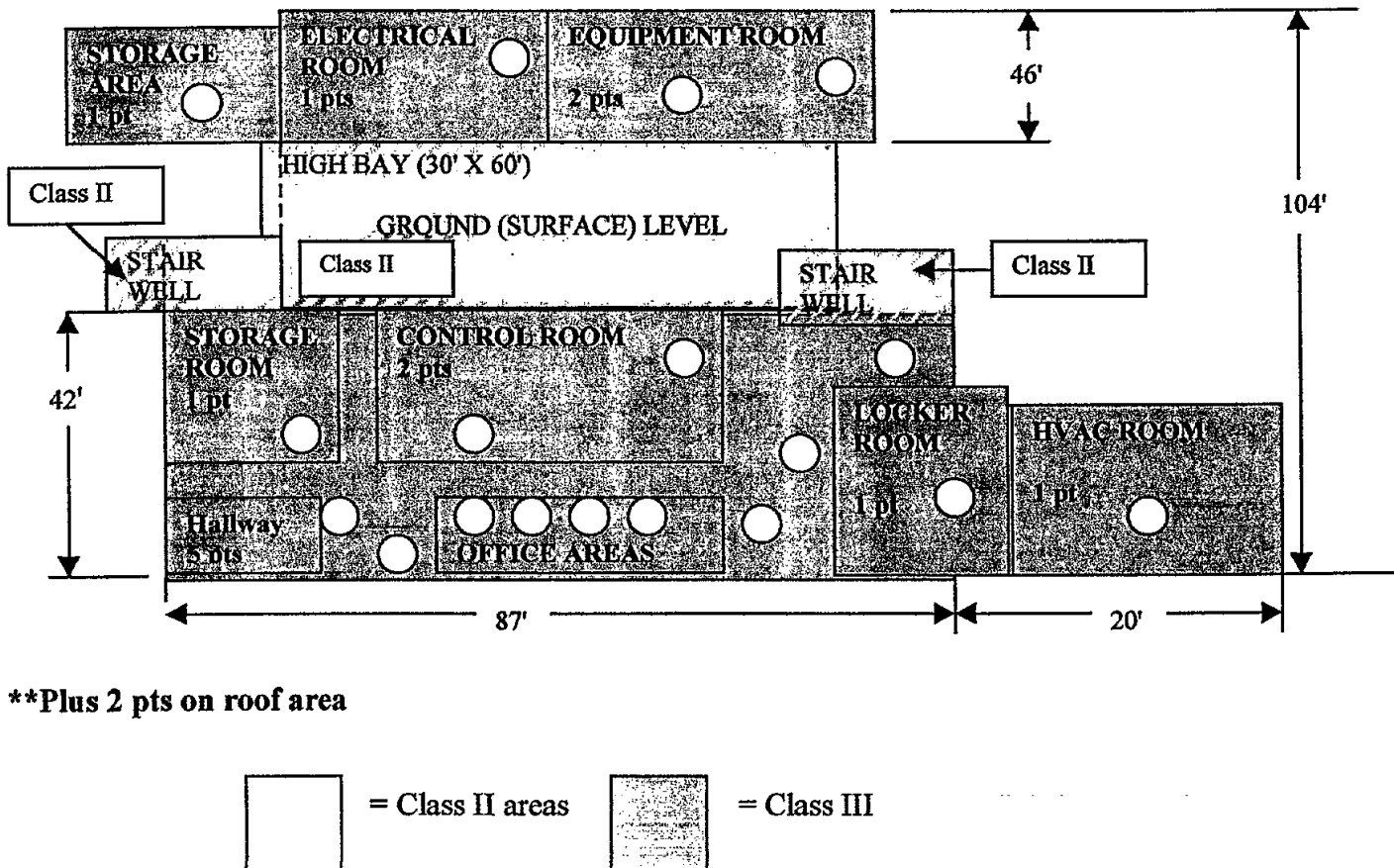


FIGURE 5: CLASS III SAMPLE POINTS

3.9 Survey Instrumentation and Survey Techniques

The following equipment and instrumentation will be required to conduct the Final Status Survey. Substitutions may occur where the equipment performance is equivalent to the instrument listed.

- Ludlum Model 22-21-ESG Scalar/Rate meter
- Tennelec Alpha/Beta Counting System
- Ludlum Model 44-9 Thin-Window Pancake GM Probe
- Ludlum Model 44-2 High-Energy Gamma Probe
- Canberra Series 100 MCA System with High-Purity Germanium/Lithium Detector
- Ludlum Model 12 Count rate Meter
- Cesium 137 check source
- Survey detector 1 meter tripod
- Survey detector balance boom
- Nuclear Power Outfitters (NPO) 1¼-inch cloth smear discs, or equivalent
- Miscellaneous non-hazardous operating supplies

3.9.1 Calibration

All portable survey instruments are serviced and calibrated on a quarterly basis. Daily checks and calibrations are performed on all instrumentation (when used) to determine acceptable performance. Daily checks and calibration data is entered on the appropriate Instrument Qualification Sheet (IQS). Reference 8.3 provides additional methods and procedures for daily instrument qualification checks

3.9.2 Representative Reference Background Areas

For the purposes of evaluating gross beta activity on structural surfaces, a building of similar construction, Building 013, will be identified on the property immediately east of the site. This building will serve as a reference for surface activity measurements. Two reference areas: one for concrete surfaces, and one for drywall surfaces are required.

3.9.3 Scan MDC

3.9.3.1 Required Scan MDC

Scanning between the grid samples will be performed to ensure that small areas of contamination do not remain undetected. From Table 5.7 of MARSSIM, PAGE 5-37, the building Area Dose Factor for Co-60 and a grid area of 5m² is 3.0. Therefore the elevated measurement concentration DCGL_{EMC} is ...

$$DCGL_{EMC} = DCGL_W \times \text{Area Factor} = 5000 \times 3 = 15,000 \text{ dpm}/100\text{cm}^2$$

The required Scan MDC is therefore...

$\text{Scan MDC (required)} = DCGL_{EMC} = 15,000 \text{ dpm}/100\text{cm}^2$

3.9.3.2 Actual Scan MDC

Measurements of the beta surface contamination are made with surface scans performed with a thin-window pancake Geiger-Mueller tube moving at approximately 1 in/sec. Actual scan MDC for this technique is calculated below following the procedure outlined in pages 6-41, 6-43 of Reference 8.1, and equation 6-10 of MARSSIM.

- Minimum Detectable Count Rate (MDCR) Table 6.6 = 60 cpm
- Instrument efficiency = $\epsilon_i = 0.12$
- Surface efficiency = $\epsilon_s = 0.9$
- Surveyor efficiency = 0.5
- Probe area = 20 cm²

- Scan MDC =
$$\frac{6.0}{(\sqrt{0.5})(0.12)(0.9)(20/100)} = 3,928 \text{ dpm}/100\text{cm}^2$$

Scan MDC (actual) = 3928 dpm/100cm²

Since the actual scan MDC of 3,928 dpm/100cm² is less than the required 15,000 dpm/100cm² scan MDC, the scanning technique is adequate for detecting hot spots above DCGL_{EMC} between the sample locations. Therefore no adjustment to the number of samples to account for elevated activity is necessary.

4.0 GENERAL REQUIREMENTS/PRECAUTIONS

4.1 Safety Precautions/ Special Instructions

- 4.1.1 Special safety hazards to personnel and/or equipment should not be present at the time of this survey. Ensure two personnel are present while working on man-lifts and ladders.

4.2 General Health and Safety Instructions

All personnel shall observe the following general instructions:

- 4.2.1 Ensure personnel working in the area are aware of the Site Emergency Evacuation Plan and will implement it as required. (Reference 8.7).
- 4.2.2 Ensure Protective Services at 65333 is available to provide first aid support when required.
- 4.2.3 Close and lock the facility after each workday.
- 4.2.4 Secure all equipment and/or materials removed from the work areas called out in this procedure at the end of each workday.
- 4.2.5 Ensure no one enters any pipe chase areas to survey without authorization, confined space monitor training, and a second person present.

4.3 Guidelines

4.3.1 Removable Contamination

The amount of removable material per 100 cm² of surface area should be determined by wiping an area of that size with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wiping with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm² is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. It is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate total residual surface contamination levels are within the limits for removable contamination.

When, contamination on objects of surface area less than 100 cm² is detected, the activity per unit area should be based on actual area and the entire surface should be wiped. It is not necessary to use the wiping techniques to measure removable contamination levels if direct scan surveys indicate total residual surface contamination levels are below the limits for removable contamination.

4.3.2 Gamma Exposure Limits

The Ambient exposure limit at 1 meter from the floor is less than or equal to (\leq) 5 μ R/hr above background.

4.3.3 Definitions

- 4.3.3.1 For purposes of this procedure, *FHP* is defined as “facility Health Physics technician” in charge of the building or field lot-decommissioning project as determined by the Radiation Safety Department.
- 4.3.3.2 For purposes of this procedure, *PIC* is defined as the “person in charge” of the remediation project for SHEA. This individual is typically the first line supervisor for ETEC
- 4.3.3.3 For purposes of this procedure, *hot spot* is defined as a small surface area reading greater than 2 times the background dose rate.

4.4 Procedural Prerequisites

CAUTION: If changes are necessary, redline the working copy of this Survey Procedure (SP) and obtain approval from the person in charge (PIC), the Operations Manager (OM), and the Radiation Safety Officer (RSO) or designee Facility Health Physics technician (FHP when applicable). In addition, changes affecting cost and scheduling must be approved and signed by the program manager (PM).

NOTES (1) General training for Radiation Safety personnel is required in accordance with Reference 8.3, 8.5, 8.6 and outlined in Appendix B of this procedure.

- (2) A single designated “working copy” of this final survey procedure will be utilized at the work site, identified as “the working copy” on the cover page, and located in an area designated for working copies.

- 4.4.1 At the completion of all tasks covered by this procedure, the working document, including all redline changes incorporated and signed, and the required Appendices, will be filed with Radiation Safety Department in the file labeled *Building 4059 Project* in building T487.
- 4.4.2 Verify site specific training of personnel working at Building 4059 has been conducted in accordance with Section 4.4, Note 1 of this procedure.

PIC: _____

- 4.3.4 Verify that each employee working in the area has attended a tailgate brief to indicate their understanding of the job and instructions.

PIC: _____

- 4.4.5 Verify that all personnel initialing redlines for signature have signed the initial verification sheet in Appendix F of this procedure.

FHP: _____

- 4.4.6 Verify all daily instrument calibrations and checks made at the beginning of the working day, at mid-day, and at the end of the workday have been conducted. The average backgrounds and efficiency factors determined at the beginning and end of each half-day shall be used with data obtained during that time period.

FHP: _____

- 4.4.7 Verify all calibration and check data shall be recorded on an Instrument Qualification Sheet (IQS) by the Facility Health Physics technician (FHP). Acceptance limits for daily checks shall be established for each instrument at $\pm 20\%$ of the initial calibration value.

FHP: _____

5.0 PROCEDURES FOR CONDUCTING SURVEY

NOTE: The following procedural steps should be completed and documented separately for each survey unit.

5.1 Survey Preparation

- 5.1.1 Obtain from the cognizant engineer (or their designee) a map of the area to be surveyed using the measurement data displaying floors, walls, ceilings, etc. Ensure the map is properly scaled to the area.
- 5.1.2 Verify the measurements of the entire area, (length, width, height, depths, doorway openings, and penetration locations) are enough to create an accurate map of the survey unit (SU) to be surveyed. Include the exterior roof sections in the vicinity of any (removed) ventilation systems
- 5.1.3 Draw on the map each survey unit (SU). Include the random starting point, sample points, and classification of each area.
- 5.1.4 Mark the boundaries of each survey unit.
- 5.1.5 Locate the random starting point, mark it, and begin marking all sample points for that SU using the specified grid spacing.

FHP: _____

5.2 Qualitative Beta Measurements

CAUTION: Asbestos containing materials should be handled by asbestos abatement trained personnel. Be aware that "black mastic" under the floor tiles can contain asbestos as a component. Notify Environmental Protection at 67257 or Health and Safety at 69295 if floor tile or mastic is suspected to be asbestos material. Asbestos tiles removed from a room or area should be double bagged and labeled.

- 5.2.1 Perform a detailed radiological scan survey, where floor covering is present, on the surface of the covering. Notify the Environmental Protection or Health and Safety to remove loose covering and all mastic if possible until the bare floor surface is exposed using appropriate radiological and environmental controls. Ensure the covering is disposed of as non-radioactive or radioactive waste identified from the survey results.
- 5.2.2 Perform a total (100%) qualitative, direct scan of each SU surface with a count rate instrument performance checked to the criteria called out in Section 6.0 of this procedure. Observe indication of any *hot spots*.

Date Completed _____ FHP: _____

- 5.2.3 Record the date, room number, survey unit, location, and instrument counts for the survey unit area scan on an FSDS (Reference 8.4).

Date Completed _____ FHP: _____

- 5.2.4 Mark the location on the room's surface area if a potential *hot spot* located reads >100 counts above the background on the detector. Reference it on the map, designate the SU and area coordinates where a maximum reading or potential *hot spot* is indicated. Verify marking any *hot spot* on the room surface and map.

Date Completed _____ FHP: _____

- 5.2.5 Notify the PIC to begin decontamination of the area if required, document the contamination levels, and re-survey that location. Record the new contamination levels.

- 5.2.6 Verify all steps called out in Section 5.2 of this procedure were conducted for beta scans.

Date Completed _____ FHP: _____

5.3 Quantitative Beta Measurements

- 5.3.1 Set the time of the count to 1 minute on the scalar detector performance checked to the criteria called out in Section 6.0 of this procedure. Uniformly scan the selected sample point(s), timing the scan so that the area is completely scanned within the five-minute period. Observe indications where radioactivity may exceed twice the background counts and mark those locations.

- 5.3.2 Record the date, room number, SU number, and total instrument counts for the sample point on an FSDS.

Date Completed _____ FHP: _____

- 5.3.3 Mark the location on the room's surface area if a potential *hot spot* located reads greater than or equal to (\geq) 2x [twice] the background counts on the detector. Reference it on the map, designate the SU and area coordinates where a maximum reading or potential *hot spot* is indicated. Verify marking a *hot spot* on the room surface and map.

Date Completed _____ FHP: _____

- 5.3.4 Notify the PIC to begin decontamination of the area if required, document the contamination levels, and re-survey that location. Record the new contamination levels.

- 5.3.5 Verify all steps called out in Section 5.3 of this procedure were conducted for beta measurements.

Date Completed _____ FHP: _____

5.4 Removable Contamination Measurements

- 5.4.1 Wipe an "S" or "Z" pattern, with limbs approximately 6 inches long, to sample removable contamination from each sample point within each SU.
- 5.4.2 If a hot spot was detected within any sample point, smear that specific area within the SU. Place the smear in an envelope kit. Record the *room number, location, date and time* on the envelopes collected. Store all envelopes for that SU together. Verify these actions were conducted.

Date Completed _____ FHP: _____

- 5.4.3 Count the envelopes containing the smears, when all the sample points for each SU have been surveyed for removable contamination, using a Tennelec gas- proportional alpha/beta counter for 1 minute and record the results.
- 5.4.4 Notify the PIC to begin decontamination of the area if required, document the contamination levels, and re-survey that location. Record the new contamination levels.
- 5.4.5 Verify all steps called out in Section 5.4 of this procedure were conducted for removable contamination.

Date Completed _____ FHP: _____

5.5 Gamma Ambient Exposure Rate Measurements

- 5.5.1 Obtain a 1- inch calibrated NaI probe connected to a scalar readout detector. Ensure the detector has been performance checked to the criteria called out in Section 6.0 of this procedure.
- 5.5.2 Position the probe over the center of each sample point on the floor in each SU. Ensure the probe is at a distance of 1-meter above the surface. Obtain a 1 minute integrated count at the selected location.
- 5.5.3 Record the date, room number, grid location, and total instrument counts for the square meter area scan on an FSDS.

Date Completed _____ FHP: _____

- 5.5.4 Mark the location on the room's surface area if a potential *hot spot* located reads greater than or equal to (\geq) 4200 counts on the detector. Reference it on the map, designate the SU and area coordinates where a maximum reading or potential *hot spot* is indicated. Verify marking a *hot spot* on the room surface and map.

Date Completed _____ FHP: _____

- 5.5.5 Notify the PIC to begin decontamination of the area if required, document the contamination levels, and re-survey that location. Record the new contamination levels.
- 5.5.6 Verify all steps called out in Section 5.5 of this procedure were conducted for gamma measurements.

Date Completed _____ FHP: _____

5.6 Survey Records

- 5.6.1 Verify one copy of the survey for the SU is attached to this procedure and provide the Radiation Safety Department with the originals for data analysis.

FHP: _____

6.0 INSTRUMENT QUALIFICATION REPORT INSTRUCTIONS

NOTE (1): Refer to appendices D and E of this procedure.

(2): *Background* and *Check Source Response* readings are required at *Shift Start*, *Mid shift*, and *Shift End*. For work scheduled on half of a shift, only *Shift Start* and *Shift End* are required.

6.1 Scalar Diagnostics

6.1.1 Record the indicated data in the *Instrument Electronics* section.

6.1.2 Record the indicated data in the *Radiation Detector* section.

6.1.3 Record the indicated data in the *Calibration* section.

NOTE: The headings *Shift Start*, *Mid shift*, and *Shift End* apply for the vertical columns in each of the block sections, or *Scalar Diagnostic*, *Background Response*, and *Check Source Response* sections.

6.1.4 Record the instrument's initial set points in the boxes located in the left-hand corner of the *Scalar Diagnostic* section of the form upon receipt of the instrument.

6.1.5 Record the battery, high voltage, and threshold set points at the beginning, middle, and end of each shift.

6.1.6 Compare the instrument set points taken during the shift to the initial set points recorded in the boxes.

6.1.7 Replace the instrument if comparable set points result in the following:

- battery reading is less than 5.4 volts,
- high voltage is less than 50 volts
- threshold value is less than 5 mV for the alpha instrument; and less than 10mV for the beta and gamma instruments.

6.2 Background Response

6.2.1 Perform two separate, 5-minute counts on the instrument, and record the data in the Count 1, and Count 2 lines.

6.2.2 Average the two results and record the total average on the *Count Average* line for *Background Response*.

6.3 Check Source Response

- 6.3.1 Perform ten separate, 5-minute counts on the instrument
- 6.3.2 Average the ten results and record the total average on all three *Expected Count* lines for *Check Source Response* upon initial receipt of the instrument.
- 6.3.3 Perform a separate, 5-minute count with the source at *Shift Start, Mid Shift, and Shift End*
- 6.3.4 Compare the [initial] *Expected Count* results to the *5 minute Count* line above.
- 6.3.5 If the [initial] *Expected Count* reading and the 5-minute count taken during the shift are greater than a 20% difference, replace the instrument and re-survey the area.
- 6.3.6 Verify one copy of the Instrument Qualification Report is attached to this procedure and provide the Radiation Safety Department with the originals for data analysis.

FHP: _____

7.0 COMPLETION REVIEW AND APPROVAL

By my signature below, I verify that all steps called out in this Procedure are signed off and complete:

PIC: _____ Date: _____

FHP: _____ Date: _____

I have reviewed this Procedure and found it to be satisfactory.

Project Engineer: _____ Date: _____

Quality Assurance: _____ Date: _____

I verify this Procedure is acceptable and available for external use.

Radiation Safety _____ Date: _____

8.0 REFERENCES

- 8.1 Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), December 1997.
- 8.2 "Two-Phase Site Release Approach to B4059 at Rocketdyne's SSFL", letter from P.Rutherford to S.Hsu (DHS), February 3, 1999, 99RC-0722.
- 8.3 Rocketdyne Document N0010P000033, "Methods and Procedures for Radiological Monitoring"
- 8.4 Rocketdyne Form 732-A, Rev. 8-97, "Radiation Survey Report"
- 8.5 Rocketdyne Document N0010P000032, "Training Program for Radiation Protection and Health Physics Personnel"
- 8.6 Document ER-AN-0005, "Training Plan for Environmental Restoration of Radioactively Contaminated Facilities", original dated September 17, 1991
- 8.7 Rocketdyne Master Emergency Plan
- 8.8 Letter from M. Lopez to M. Lee, "B4059 D&D Approval," January 29, 1999.
- 8.9 Letter from R. Lupo to P. Rutherford, "Untitled," March 12, 1999, 002002AC.

9.0 APPENDICES

APPENDIX A

FIELD SURVEY DATA SHEET

DATE _____ BUILDING _____ PAGE ____ OF ____

[illegible][illegible]

SURVEYED BY _____ SIGNATURE _____

REVIEWED BY _____ SIGNATURE _____

APPENDIX B**Building 4019 Survey Training Requirements**

Qualification/Training	¹Course No.	Facility Mgr.	PIC	Techs.	Rad. Safety	H&S	Env. Rem.	Others
Medical Surveillance:								
Radiation Dosimetry	-	-	X	X	X	² X	² X	² X
Respirator Qualified	-	-	X	X	-	-	-	-
Training:								
Radworker I Qualified	4013 5078	X	-	-	-	³ X	³ X	³ X
Radworker II Qualified	4013 4071 4072	-	X	X	X	-	-	-
Haz. Mat'l Comm.	4010		X	X	X	X	X	X
⁵ Half Mask MSA	1030	-	X	X	-	X	X	-
⁵ Full Face Mask	1032	-	X	X	-	X	X	-
⁵ Haz. Waste Pkg. & Trans.	4028-1	-	X	X	X	-	-	-
⁵ Haz. Waste Handling	4004	-	X	X	X	-	-	-
⁴ Fork Lift	2003	-	-	X	-	-	-	X

1. Course number from Technical Skills & Development Department.
2. Applies when entry into a radiation area is planned.
3. Applies when work in radiation area is planned.
4. Required for operators of equipment only.
5. As required.

APPENDIX C

DOCUMENT SIGN-OFF FORM

[illegible]

APPENDIX D

GAMMA INSTRUMENT QUALIFICATION DATA SHEET

Radiation Safety Gamma Daily Instrument Qualification Report

Instrument Electronics		Radiation Detector	
Boeing #: _____	Mfgr. S/N: _____	Boeing #: _____	Mfgr. S/N: _____
Mfgr. _____	Model: _____	Mfgr. _____	Model: _____
		Det. Eff _____	% _____
Calibration			
Last Calibrated: _____		Calibration Due: _____	
Field Check Source			
Source I.D.: _____	Isotope _____	Activity _____	
Instrument Qualification Data			
Check Time: _____	Shift Start: _____	Mid-Shift: _____	Shift End: _____
Scaler Diagnostic			
Initial	Bat: _____ V	_____ V	_____ V
	HV: _____ V	_____ V	_____ V
	Thresh: _____ mV	_____ mV	_____ mV
Background Response			
5 Min. Count 1	_____ c/5m	_____ c/5m	_____ c/5m
5 Min. Count 2	_____ c/5m	_____ c/5m	_____ c/5m
5 Min. Count Avg.	_____ c/5m	_____ c/5m	_____ c/5m
Check Source Response			
5 Min. Count	_____ c/5m	_____ c/5m	_____ c/5m
Expected Count	_____ c/5m	_____ c/5m	_____ c/5m

Completed By: _____ Signature: _____ Date: _____

Project: _____

APPENDIX E

BETA INSTRUMENT QUALIFICATION DATA SHEET

Radiation Safety Beta Daily Instrument Qualification Report

Instrument Electronics		Radiation Detector	
Boeing #: _____	Mfgr. S/N: _____	Boeing #: _____	Mfgr. S/N: _____
Mfgr. _____	Model: _____	Mfgr. _____	Model: _____
		Det. Eff _____	% _____
Calibration			
Last Calibrated: _____		Calibration Due: _____	
Field Check Source			
Source I.D.: _____		Isotope _____ Activity _____	
Verified By: _____			
Due: _____			
Instrument Qualification Data			
Check Time: _____	Shift Start: _____	Mid-Shift: _____	Shift End: _____
Scaler Diagnostic			
Initial			Limit
<input type="text"/>	Bat: _____ V	_____ V	_____ V
<input type="text"/>	HV: _____ V	_____ V	_____ V
<input type="text"/>	Thresh: _____ mV	_____ mV	_____ mV
Background Response			
5 Min. Count 1	_____ c/5m	_____ c/5m	_____ c/5m
5 Min. Count 2	_____ c/5m	_____ c/5m	_____ c/5m
5 Min. Count Avg.	_____ c/5m	_____ c/5m	_____ c/5m
Check Source Response			
5 Min. Count	_____ c/5m	_____ c/5m	_____ c/5m
Expected Count	_____ c/5m	_____ c/5m	_____ c/5m

Completed By: _____ Signature: _____ Date: _____

Project: _____

APPENDIX F

[RED LINE SIGNATURE SHEET]

I verify by my signature below that I have notified the PIC, RSO, OM, and PM (as appropriate)
of my changes to this procedure.

NAME	SIGNATURE	WORK GROUP DATE
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NAME	SIGNATURE	WORK GROUP DATE
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NAME	SIGNATURE	WORK GROUP DATE
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NAME	SIGNATURE	WORK GROUP DATE
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NAME	SIGNATURE	WORK GROUP DATE
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NAME	SIGNATURE	WORK GROUP DATE
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NAME	SIGNATURE	WORK GROUP DATE
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NAME	SIGNATURE	WORK GROUP DATE
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NAME	SIGNATURE	WORK GROUP DATE
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NAME	SIGNATURE	WORK GROUP DATE
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APPENDIX G**[PROCEDURE TAILGATE]**

I VERIFY BY MY SIGNATURE BELOW THAT I HAVE READ THE BUILDING 4019
PROCEDURE BEFORE CONDUCTING ANY WORK.

NAME	SIGNATURE	WORK GROUP	DATE
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NAME	SIGNATURE	WORK GROUP	DATE
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NAME	SIGNATURE	WORK GROUP	DATE
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NAME	SIGNATURE	WORK GROUP	DATE
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NAME	SIGNATURE	WORK GROUP	DATE
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NAME	SIGNATURE	WORK GROUP	DATE
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NAME	SIGNATURE	WORK GROUP	DATE
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NAME	SIGNATURE	WORK GROUP	DATE
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NAME	SIGNATURE	WORK GROUP	DATE
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